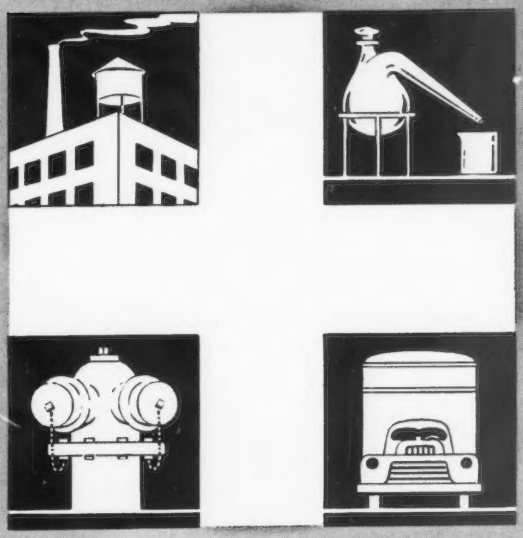
The Journal

OF THE AMERICAN SOCIETY OF SAFETY ENGINEERS



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Journal Ends Association With National Safety News

■ THIS ISSUE OF the *Journal of the American Society of Safety Engineers* marks the end of an association with the *National Safety News* which began in February, 1956. During these past six years the Society has produced 23 issues with a total of 81 articles, in addition to the special issue (August, 1960) on "Today's Safety Engineer," a report of a study of the Society's membership made by the Special Committee on Membership Services.

In the pages of the *Journal* there have been papers by such outstanding safety and industrial figures as H. W. Heinrich, Roland P. Blake, Nobel Prize Winner Dr. Herman J. Muller, Arthur S. Johnson, Morehead Patterson, John A. Dickinson, Ewan Clague and George Romney, President of American Motors.

Noted leaders of the Society have also contributed worthwhile articles. Some of these are John V. Grimaldi, Daniel F. Hayes, C. Russell DeReamer, Robert J. Dougherty, Robert D. Gidel, Merrill C. M. Pollard, Arthur J. Naquin, the Late Robert Clair, Walter E. Montgomery, Myron L. Miller and Thomas H. Rockwell, whose second paper appears in this issue (see page 42).

These 23 issues of the Journal have set a standard representing the highest level of professionalism in the field of safety engineering. Now that we are embarking on a new venture (see Our President Speaks on Safety – next page), we hope to continue meeting this high level by providing safety engineers with the kind of information they require to perform their duties effectively – *the Editor.*

AMERICAN SOCIETY OF SAFETY ENGINEERS

Organized 1911 — Chartered 1915

5 North Wabash Avenue, Chicago 2, Ill.

A. C. BLACKMAN
managing director

LEONARD LEVINE
editor

OFFICERS, 1960-61

president

GEORGE L. GORBELL

manager of safety and fire protection, Monsanto Chemical Co., St. Louis, Missouri

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A. C. BLACKMAN

managing director, American Society of Safety Engineers, Chicago, Illinois

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OUR PRESIDENT SPEAKS ON SAFETY

IN FEBRUARY, 1956, Edward B. Landry, then president of our Society, wrote "The publication of this first issue of the Journal of the American Society of Safety Engineers is an important step in the development and growth of the Society. It is a mark of progress of which all members of the Society can be proud."

Now, almost six years later, the Society is approaching another milestone. In October we will publish our own independent Journal on a monthly basis.

The Journal has, over the past six years, fulfilled the purposes for which it was intended. Its pages have contained articles of a technical and informational nature intended to elevate the profession of safety engineering and to broaden the understanding and experience of those engaged in the practice of this profession.

During the past six years, the Society has undergone many changes. Most of these have been directed toward the one purpose of giving the Society more vitality and independence and enabling it to better serve its members.

The concept of an independent Society Journal has long been envisioned by farsighted leaders of our Society. In 1956, because of our limited resources, we accepted the offer made by the National Safety Council to publish our Journal as a quarterly supplement to the *National Safety News*. This joint venture was a further expression of the close bond which has existed between our two organizations since the years of our founding. The support and guidance of the National Safety Council has helped make it possible for us now to embark upon this new venture.

The purposes of the new Journal will be to help widen the horizon of the safety engineer and to improve his professional status. By doing this we will enhance the entire profession and make it possible for the safety engineer to make an even greater contribution toward the reduction of injury and death through accidents.

Historically, our new Journal appears as the culmination of a long line of communications efforts. Starting with a modest newsletter in the early years of our history, our publications have improved gradually to the point where we are regularly producing two periodicals and have published several individual handbooks and monographs. With increased revenue through the expansion of the new Journal, we can see the day when we may have several periodicals and many other services intended to help the safety engineer in his search for new and useful information.

With these expanded resources, we can also see a more universal understanding and acceptance of the safety engineering profession and increased recognition of the Society as a result of its greater contribution to the field of safety.

The departure of the Journal from the *National Safety News* in no way reflects upon the relationship between our Society and the National Safety Council. We will continue, as we have in the past, to cooperate with the Council in the development of technical and research materials and in other areas of activity in safety. Considering the interrelated activities of the leaders of the Society and the Council, it is inconceivable that our two organizations should not continue this fine cooperative relationship.

It has been my privilege to participate in the planning and deliberations preparatory to publishing our Journal this fall. For many months our staff has been involved with the myriad of details necessary to make the publication a reality and we are now entering the final stages. I know you share with me the hopes and pride in this new venture and I am sure you will do all you can toward making it a successful one.

George L. Gorbell

GEORGE L. GORBELL, PRESIDENT
AMERICAN SOCIETY OF SAFETY ENGINEERS

Accident Rates and Changes IN THE EMPLOYMENT LEVEL

by ANN STRESAU

ORGANIZATION OF DATA

Industrial injury rates expressed in "number of cases per million manhours" were available for minor cases, (first aid treatment), doctor's cases, (medical treatment required), and disabling injuries. Rates of doctor's cases and frequency rates of disabling cases for 152 months from August, 1947, to June, 1960, figured on a monthly basis were used in conjunction with a study of weekly rates for 111 weeks from January, 1958, to June, 1960.

Studies of the rates of minor cases, on the other hand, cover 87 months on the monthly basis and 49 weeks when rates could be figured on a weekly basis. It was felt that weekly rates would be more sensitive while monthly rates would reflect general trends. The balance of these two approaches enhances the reliability of the conclusions.

Rising and falling employment is based on a percentage of the average employment. For example, in the 111 weeks from January, 1958, to June, 1960, the average employment was 8,300. This, then, was considered to be an index of 100. Add 83 employes or 1% and the index will be 101. A change of 1 point in the index compared to the index of the week immediately preceding would consistitute a rise or fall in employment for that week. No change in the index would be considered a "stable" employment. The same principle was used in studying the monthly rates.

Periods of high employment and low employment do not necessarily coincide with periods of rising and falling employment. Thus, they were analyzed separately.

To determine whether or not differences in percentages were statistically significant, an "omega" nomograph prepared by C. H. Lawske and P. C. Baker of the Occupational Research Center, Purdue University, was used. Omega is based on the number of monthly or weekly rates used in the study. By comparing the "omega achieved" as determined by the nomograph with the "omega needed" determined by a formula, one can decide whether or not a difference is significant.

"Omega achieved" is further used in determining values of "t", the standard statistical value which is used in finding the changes in 100 that a percentage difference could have occurred by chance. If a difference could have occurred by chance more than 5 times in 100, this would not be considered a significant difference in this study. In other words, the 95% confidence level is used as the basis for significance.

Significant differences in means, rather than percentages, have been determined by comparing actual differences with the standard error of the difference.

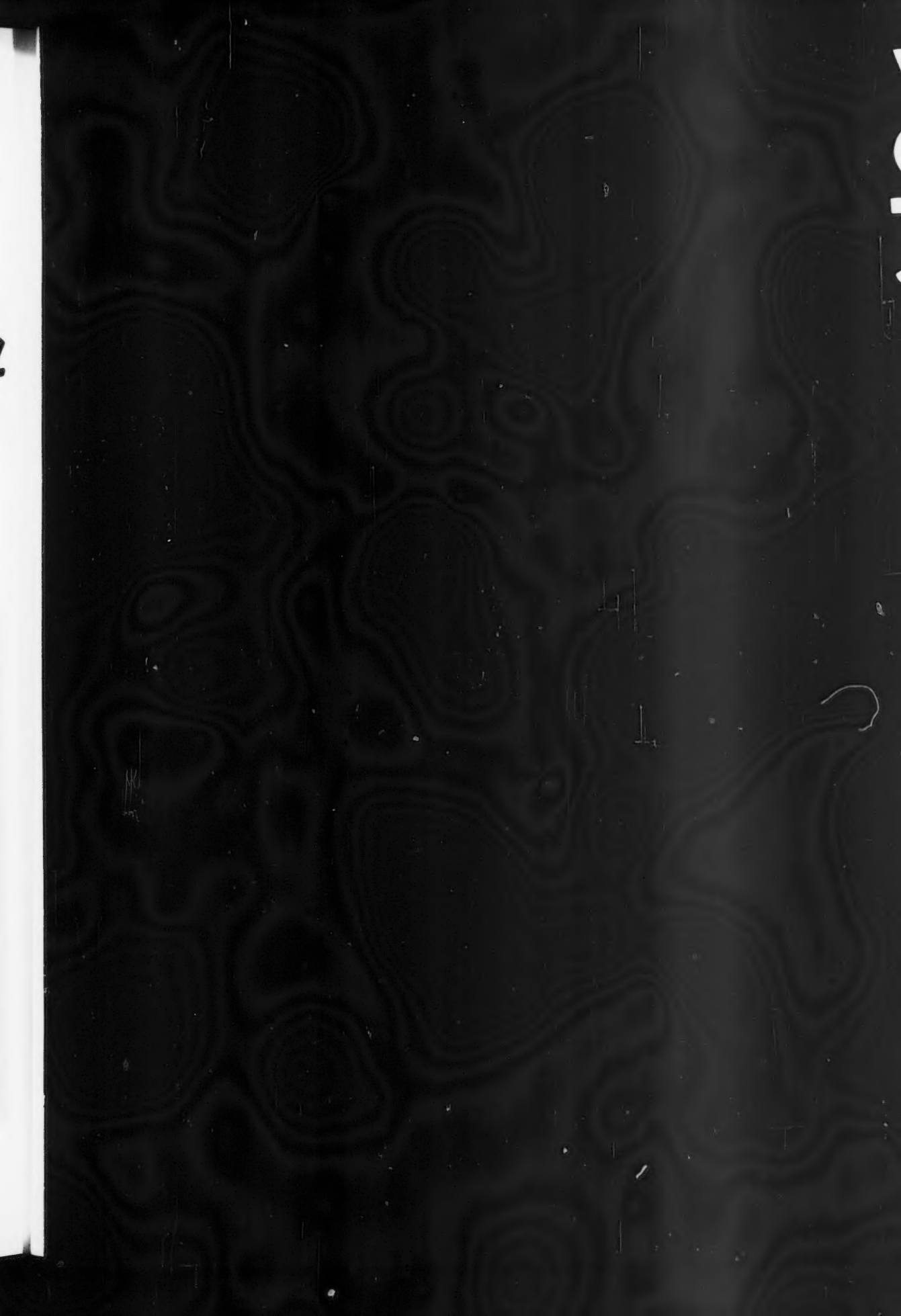

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TABLE I AVERAGE RATES DURING CHANGING EMPLOYMENT

Average Rates of:	Weekly rates study: Falling Employment	Weekly rates study: Stable Employment	Weekly rates study: Rising Employment	Monthly rates study: Falling Employment	Monthly rates study: Stable Employment	Monthly rates study: Rising Employment
Minor Cases	1513 ± 120	1623 ± 222	1804 ± 268	956 ± 115	988 ± 122	992 ± 141
Doctor's Cases	55.0 ± 13.4	59.0 ± 16.8	59.2 ± 14.4	44.6 ± 11.2	46.3 ± 11.7	48.9 ± 10.2
Disabling Cases	5.7 ± 3.9	5.5 ± 4.4	5.8 ± 4.8	9.0 ± 5.5	10.2 ± 5.4	11.0 ± 5.8

Note: Rates for weekly rates are based on "shop" hours only and are therefore generally higher.
Frequency rates at the West Allis Works have fallen substantially during the 13 years of the "Monthly Rates Study." Therefore, although the weekly rates are higher than they would be if salary hours were included, the monthly rates are even higher since they cover a much longer period of time.

Analysis of above data showing how many times in 100 the difference could occur by chance

	Weekly rates study: Falling vs Stable	Weekly rates study: Rising vs Stable	Weekly rates study: Rising vs Falling	Monthly rates study: Falling vs Stable	Monthly rates study: Rising vs Stable	Monthly rates study: Rising vs Falling
Minor Cases	4*	2*	.01*	15	46	15
Doctor's Cases	12	48	13	24	15	1*
Disabling Cases	41	39	46	15	25	3*

*Less than 6 times in 100; therefore significant at the 95% confidence level

Ann Strasau, supervisor of safety education and statistics at Allis-Chalmers Manufacturing Co., Milwaukee, has been with the company in safety work for many years. Miss Strasau holds a BA degree in psychology from the University of Wisconsin and has presented several papers before safety conferences.

DO PERIODS OF increasing or decreasing employment have any significant effect on accident rates? Are accident rates more likely to be high or low during periods of high employment?

Studies have shown that inexperienced employees have higher rates than experienced men and this could affect the entire plant rate during a period of rising employment.

In addition rates could be expected to increase during periods of falling employment when considerable transferring of workers from one job to another might lead to higher accident rates.

A survey conducted by Allis-Chalmers, West Allis Works, Safety Services Section, disclosed that high and low levels of employment affected accident rates and these rates were sometimes affected during the rising and falling periods as had been suspected.

On Table I are the average rates of minor cases, doctor's cases, and disabling cases during periods of rising, falling, and stable employment. Following each average rate is a tolerance expressed in terms of the standard deviation.

ANALYSIS OF DATA

An analysis of this data shows that in the year between April, 1959, and April, 1960, the average rate of minor cases was significantly higher during periods of rising employment and significantly lower during falling employment. No significant differences were found in the longer study.

When the data was analyzed similarly for the periods from 1947 to 1954 and from 1955 to 1960, the relationship persisted. This test substantiates the reliability of the study and shows the effect of new employees on the rates during periods of rising employment. A high rate of transferring, however, did not affect the relationship in a falling employment.

DISABLING INJURIES

Disabling Cases – The relationship between changing employment and frequency rate of disabling injuries is not as marked. In the weekly study covering a year and a half, no significant differences were found. (Table VI) However, in the long term study of monthly rates, (Table VII) high rates of injury accompanied rising employment 51% of the time, while high rates occurred during falling employment only 34% of the time. This is a true difference at the 94% confidence level and thus can be considered virtually significant.

RATES HIGHER DURING RISE

Although no significant differences were found between rising and stable or falling and stable employment conditions, the fact that rates were significantly higher on the average (Table I) during rising employment and lower during falling employment adds fuel to the conclusion that there is some relationship between the rate of disabling cases and changing employment.

Severity Rate and Days Lost per Disabling Cases – Although there were no significant differences found when comparing severity rates during falling employment versus stable employ-

Employment Status	Rate of Injuries	Number of times employment status occurred	Number of times rate was high or low as stated	% of times rate was high or low as stated	Omega achieved from these %'s	t score	Omega needed for difference to be significant	Chances in 100 that difference could be due to chance	Significant Difference?
TABLE II MINOR CASES RATE FOR 49 WEEKS FROM APRIL 1959 TO APRIL 1960									
Falling Stable	High High	14 19	1 4	7 % 21 %	.29	1.166	.49	29	No
Rising Stable	High High	16 19	9 4	56 % 21 %	.53	2.207	.47	4	Yes
Rising Falling	High High	16 14	9 1	56 % 7 %	.65	2.509	.51	2	Yes
Falling Stable	Low Low	14 19	9 11	64 % 58 %	.11	.4416	.49	65	No
Rising Stable	Low Low	16 19	6 11	38 % 58 %	.28	1.166	.47	25	No
Rising Falling	Low Low	16 14	6 9	38 % 64 %	.37	1.428	.51	15	No
High Low	High High	26 23	17 6	65 % 26 %	.55	2.716	.40	1	Yes
High Low	Low Low	26 23	9 17	35 % 74 %	.57	2.815	.40	1	Yes

TABLE III MINOR CASES RATE FOR 87 MONTHS FROM JANUARY 1953 TO JUNE 1960									
Falling Stable	High High	40 23	7 6	17½% 26 %	.15	.810	.36	40	No
Rising Stable	High High	24 23	7 6	29 % 26 %	.04	.1939	.40	85	No
Rising Falling	High High	24 40	7 7	29 % 17½%	.19	1.041	.36	30	No
Falling Stable	Low Low	40 23	12 6	30 % 26 %	.07	.378	.36	72	No
Rising Stable	Low Low	24 23	6 6	25 % 26 %	.02	.0969	.40	95	No
Rising Falling	Low Low	24 40	6 12	25 % 30%	.08	.4382	.36	65	No
High Low	High Low	41 46	12 32	29 % 69½%	.58	.3819	.30	.1	Yes
High Low	Low Low	41 46	29 14	71 % 30½%	.61	.4017	.30	.1	Yes

TABLE IV DOCTOR'S CASES RATE FOR 111 WEEKS FROM JANUARY 1958 TO MAY 1960									
Falling Stable	High High	34 48	8 16	23½% 33⅓%	.16	1.010	.31	31	No
Rising Stable	High High	28 48	7 16	25 % 33⅓%	.14	.832	.33	40	No
Rising Falling	High High	28 34	7 8	25 % 23½%	.04	.171	.46	85	No
Falling Stable	Low Low	34 48	8 11	23½% 23 %	.01	.0631	.31	95	No
Rising Stable	Low Low	28 48	5 11	18 % 23 %	.11	.6539	.33	55	No
Rising Falling	Low Low	28 34	5 8	18 % 23½%	.11	.4708	.46	65	No
High Low	High High	59 52	33 18	56 % 35 %	.30	2.241	.26	3	Yes
High Low	Low Low	59 52	26 34	44 % 65 %	.30	2.241	.26	3	Yes

ment or rising versus stable employment, a very great difference was found to exist when falling employment was compared to rising employment. The severity rate was above average 56% of the time during rising employment while it was high only 32% of the time during falling employment. (Table VIII)

The data also show that the average rates of both doctor's cases and disabling cases were significantly higher during rising employment as compared to falling employment in the long run.

AVERAGE RATES

These general trends are based on average rates in the various periods covered. But is the rate more often high or more often low during these periods? This question is answered by the data in Tables II and IX. Conclusions based on this analysis follows:

Minor Cases – The rates of minor injuries were high more often during rising employment in the weekly study, but in the longer run of monthly rates, this was not necessarily true. (Tables II and III) During 1959, there was an intensive effort at the West Allis Works to complete production that had been held up during labor difficulties that spring. It is likely, therefore, that this relationship between rising employment and high rates of minor injuries exists during periods when employment increases rapidly and the plant is exceptionally busy but not during periods of normal increases in employment.

DOCTOR'S CASES UP

Doctor's Cases – The rates of doctor's cases in the long run study were more frequently high during increases in employment. This did not hold true in the short term study of weekly rates. (Tables IV and V) There are

TABLE V DOCTOR'S CASES RATE FOR 152 MONTHS FROM AUGUST 1947 TO JUNE 1960

Employment Status	Rate of Injuries	Number of times employment status occurred	Number of times rate was high or low as stated	% of times rate was high or low as stated	Omega achieved from these %'s	t score	Omega needed for difference to be significant	Chances in 100 that difference could be due to chance	Significant Difference?
Falling	High	62	14	22 %	.03	.2006	.29	80	No
Stable	High	35	8	23 %					
Rising	High	55	24	44 %	.32	2.093	.30	5	Yes
Stable	High	35	8	23 %					
Rising	High	55	24	44 %	.33	2.519	.36	2	Yes
Falling	High	62	14	22 %					
Falling	Low	62	48	78 %	.03	.2006	.29	80	No
Stable	Low	35	27	77 %					
Rising	Low	55	31	56 %	.32	2.093	.30	5	Yes
Stable	Low	35	27	77 %					
Rising	Low	55	31	56 %	.33	2.519	.36	2	Yes
Falling	Low	62	48	78 %					
High	High	71	49	69 %	.46	4.002	.225	.1	Yes
Low	High	81	30	37 %					
High	Low	71	22	31 %	.46	4.002	.225	.1	Yes
Low	Low	81	51	63 %					

TABLE VI FREQUENCY RATES FOR 111 WEEKS FROM JANUARY 1958 TO MAY 1960

Falling	High	34	12	35 %	.20	1.262	.31	22	No
Stable	High	48	10	21 %					
Rising	High	28	8	28½%	.11	.654	.33	51	No
Stable	High	48	10	21 %					
Rising	High	28	8	28½%	.10	.428	.46	64	No
Falling	High	34	12	35 %					
Falling	Low	34	5	15 %	.15	.9465	.31	35	No
Stable	Low	48	11	23 %					
Rising	Low	28	6	21½%	.03	.1784	.33	85	No
Stable	Low	48	11	23 %					
Rising	Low	28	6	21½%	.11	.4708	.46	62	No
Falling	Low	34	5	15 %					
High	High	59	37	63 %	.24	1.793	.26	7	Almost
Low	High	52	24	46 %					
High	Low	59	22	37 %	.24	1.793	.26	7	Almost
Low	Low	52	28	54 %					

TABLE VII FREQUENCY RATES FOR 152 MONTHS FROM AUGUST 1947 TO JUNE 1960

Falling	High	62	21	34 %	.01	.0669	.29	95	No
Stable	High	35	12	34½%					
Rising	High	55	28	51 %	.23	1.504	.30	15	No
Stable	High	35	12	34½%					
Rising	High	55	26	51 %	.25	1.909	.26	6	Almost
Falling	High	62	21	34 %					
Falling	Low	62	30	48½%	.04	.268	.29	79	No
Stable	Low	48	16	46 %					
Rising	Low	55	20	36½%	.13	.850	.30	39	No
Stable	Low	35	16	46 %					
Rising	Low	55	20	36½%	.16	1.222	.26	23	No
Falling	Low	62	30	48½%					
High	High	71	44	62 %	.62	5.394	.225	.1	Yes
Low	High	81	17	21 %					
High	Low	71	17	24 %	.54	4.698	.225	.1	Yes
Low	Low	81	49	61 %					

chance factors which may vary the number of doctor's cases and their effect will be felt more acutely when rates are figured on a weekly basis. Thus, the weekly rate vacillates widely and does not hold a relationship to anything that increases or decreases steadily.

The monthly rate, on the other hand, becomes a more valid measure of experience because the sampling is greater and the chance factors are somewhat alleviated.

This could be expected since the rate of disabling cases increased during rising employment. This finding leads to the question of whether cases are likely to be more severe during rising employment.

SEVERITY UNAFFECTED

The number of "days lost per disabling injury" has been used as a measure to answer this question. A similar survey of 152 months showed that individual cases were not likely to be more severe during rising employment nor during falling employment. In fact, there were no significant differences found in any of the comparisons using "days lost per disabling case."

There is a high relationship between the rate of minor cases and the employment level. Tables II and III indicate that in both the weekly and monthly rate studies, high rates occurred most frequently during periods of high employment and low rates accompanied low levels of employment.

The same relationships existed in the studies of doctor's cases and disabling cases, (Tables IV to VII). The only doubt cast on this trend is in the weekly study

Employment Status	Rate of Injuries	Number of times employment status occurred	Number of times rate was high or low as stated	% of times rate was high or low as stated	Omega achieved from these %'s	t score	Omega needed for difference to be significant	Chances in 100 that difference could be due to chance	Significant Difference?
TABLE VIII SEVERITY RATE FOR 152 MONTHS FROM AUGUST 1947 TO JUNE 1960									
Falling Stable	High High	62 35	20 15	32 % 43 %	.16	1.070	.29	28	No
Rising Stable	High High	55 35	31 15	56 % 43 %	.19	1.243	.30	22	No
Rising Falling	High High	55 62	31 20	56 % 32 %	.35	2.672	.26	1	Yes
Falling Stable	Low Low	62 35	28 16	45 % 46 %	.02	.134	.29	89	No
Rising Stable	Low Low	55 35	20 16	36⅓% 46 %	.14	.916	.30	35	No
Rising Falling	Low Low	55 62	20 28	36⅓% 45 %	.12	.916	.26	34	No
High Low	High High	71 81	37 28	52 % 36 %	.22	1.914	.225	6	Almost
High Low	Low Low	71 81	22 43	31 % 53 %	.33	2.871	.225	1	Yes

TABLE IX DAYS LOST PER DISABLING CASE FOR 152 MONTHS FROM AUGUST 1957 TO JUNE 1960									
Falling Stable	High High	62 35	32 15	52 % 43 %	.12	.803	.29	44	No
Rising Stable	High High	55 35	33 15	60 % 43 %	.24	1.570	.30	15	No
Rising Falling	High High	55 62	33 32	60 % 52 %	.11	.840	.26	40	No
Falling Stable	Low Low	62 35	30 20	48 % 57 %	.13	.870	.29	38	No
Rising Stable	Low Low	55 35	22 20	40 % 57 %	.24	1.570	.30	13	No
Rising Falling	Low Low	55 62	22 30	40 % 48 %	.12	.916	.26	35	No
High Low	High High	71 81	35 46	49 % 57 %	.12	1.044	.225	30	No
High Low	Low Low	71 81	36 35	51 % 43 %	.12	1.044	.225	30	No

of frequency rates. Here the difference can be certain at the 93% confidence level. This is close enough to a significant difference to show some relationship.

Conclusions – The results of this study have shown that:

1. Minor cases increase when employment increases if the rate of employment increase is great and the shop is exceptionally busy.
2. Doctor's cases will likely increase when employment increases.
3. Disabling cases probably increase with rising employment.
4. The severity rate increases with rising employment.
5. The number of "days lost per disabling case" is not related to changes in employment.
6. Neither the frequency of cases nor the severity increases when employment decreases.
7. Rates of all kinds of cases and the severity rate are higher when employment is high and lower when the level of employment is low.
8. The number of "days lost per disabling case" is not related to the level of employment.

A view of the access road built by McNamara-Hislop crews into Tower Site 132, Whitehorse, Yukon Territory, which is Mile 918 on the Alaska Highway. This road winds for eight miles up Canyon Mountain to the site. A total of 42 microwave towers were built along 1,250 miles of the Highway.

Photos by McNamara Construction Ltd., Toronto

MICROWAVE PROJECT——YUKON TERRITORY

by **DENNIS E. GLASGOW**

INTRODUCTION – The rapid expansion of construction in the Yukon Territory has made it increasingly important to reduce the number and cost of accidents as reflected in insurance rates and direct job costs such as work stoppages, equipment damage, work to do over and loss of experience and manpower.

A good safety record is made difficult in the Yukon in comparison with that of other locations because of the rough terrain, adverse weather, labor turnover, long working hours and movement of personnel from one location to another. Many of the accidents though, are recurrences of the same basic causes and are evidence that more can be done to reduce the number.

Most contractors and superintendents freely admit that too many accidents occur because the work is hazardous and because it does present many difficulties in accident prevention. The industry for some time has realized that the reduction of accidents must be given more attention.

Safety rules by themselves will not assure a good safety record. It can be secured only by constant and careful attention on the part of the foreman and superintendents and through the cooperation of employees. On this project employees have been aware of the importance placed on safety.

ANYONE WHO MIGHT believe that the pioneering era of heavy construction in North America is over, would soon have such thoughts dispelled by a trip to the far-flung R. C. A. Victor microwave project being built by McNamara-Hislop. On towers scattered along 1,250 miles of the Alaska Highway from Grande Prairie, Alberta, Canada, through Northeastern British Columbia and the Yukon-Alaska border, crews are working in virgin territory, gouging out microwave tower sites (which are mainly built on the top of high mountains) and access roads in the wilderness of British Columbia and the Yukon which has never before been visited by men or machines. On such sites as 8-Mile Creek, Canyon Mountain and Sagish Mountain, crews have pushed

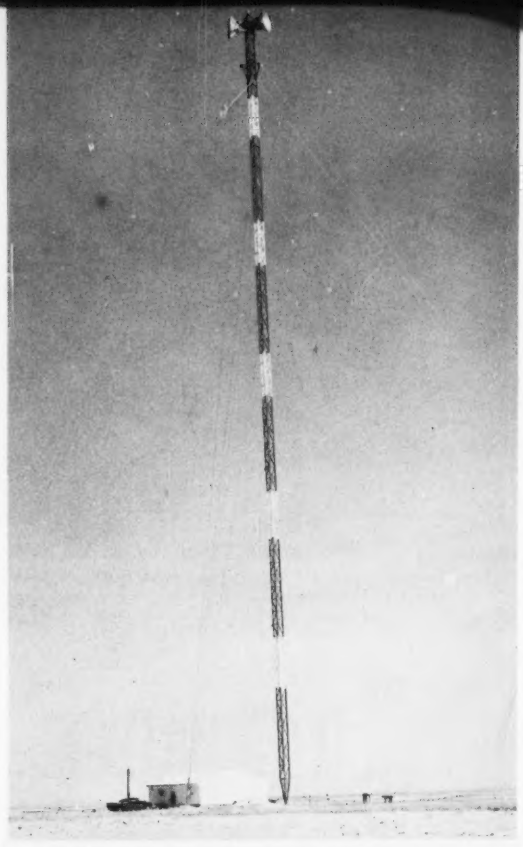
Dennis E. Glasgow, safety engineer with America Fore Loyalty Group, was safety supervisor for McNamara-Hislop during the construction of a microwave line for R.C.A. Victor from Grande Prairie, Alberta, Canada, to Fairbanks, Alaska—a distance of 1,250 miles. This article was written as the project was being completed. Prior to this Mr. Glasgow was safety supervisor for Dutton-Williams Bros. B.C., Canada.

through roads upto 14 miles in length, and where drill crews had to be extended out by ropes and belts, to drill holes for blasting on the sides of mountain tops in as rugged and remote locations as exist in North America.

To make sure of the highest safety precautions all new men as well as those familiar with this type of work are briefed every day on the hazards of this dangerous operation. Special attention is paid to the new man and a check is made on him every day to make certain he is working safely and is wearing proper safety equipment. One weak link in his safety belt or rope might cause him to drop 1,000 feet. When drilling out on the side of a mountain any defect in equipment might mean certain death. Therefore the standard rule is that every man is responsible for its upkeep and maintenance. On the job the foreman also makes a safety check on his men's equipment as a double precaution.

Even in July, it is not uncommon to see a fresh snowfall in the morning on the peaks of the mountains on which these roads are being built.

While this is pioneering work in every sense of the word, it is pioneering in a modern manner since the road-building and concrete crews operate from modern and well-equipped mobile trailer camps, which also include the newest of heavy construction equipment.



A typical completed tower site—one of the 42 on the project. Note the comparative size of the automobile and service building at the base of the tower.

ONE HOUR OF DARKNESS

One safety factor provided by the Yukon Territory is that during the summer months when two 10 hour shifts per day are working, there is only one hour of darkness. During this one hour, visibility is still clear up to about 200 feet.

To date there have been no serious accidents on this project, which I believe should be credited to the safety experience of the superintendents and foremen. Working conditions on the project carry the maximum safety procedures, which to date have paid off. But the construction of the microwave is like most construction conducted under anything but ideal conditions. The Yukon terrain can vary from pure soap to granite. Weather seems always to be unworkably wet to blisteringly hot.

Factors such as inexperience, high movement and hazardous conditions all combine to make it more than unusually difficult to start and maintain an effective kind of accident prevention program in the construction industry. However, in spite of these factors it is still true that most accidents even here are the result of ignorance or disdain for the most basic safety rules.

The educational nature of a safety program requires the interest and participation of the men for whom it is designed. This is taken care of by meetings of the safety personnel with the working personnel, where the latter can voice their ideas and opinions of the program and how well it is succeeding.

Safety in this industry (as almost everywhere else) is an educational job. The superintendents and foremen have to be educated to take an active interest in the safety program. The line operating people have to be educated to operate in accordance with this program.

Now for the building of the microwave in detail. The total project calls for approximately 130,000 yards of gravel, 80,000 yards of rock excavation and 6,000 yards of concrete. Most of the access roads call for a 60 to 100 foot right-of-way, adequate ditching, and placing of 6 inches of gravel on the 12 foot crown.

The standard tower site is 600 feet square with security fencing enclosing an area 400 feet square. This area houses the tower service building and the anchor blocks from which steel guy cables are attached to the towers for support. The towers them-

selves vary from 45 feet to 345 feet in height, depending on their location, with the shorter towers being erected on the mountain sites, and the taller ones on more level terrain. The circular concrete bases on which the towers rest are 30 inches in diameter, while the footings are 5 feet square.

At the sites with high towers, six anchor blocks are required for the 5/8 inch and 7/8 inch steel guy cables which support the towers. These are arranged in an outer perimeter of three blocks, from which the cables leading to the top half of the tower are strung and an inner perimeter of three blocks which hold the cables supporting the lower half of the towers. (A converted tank is used to put these towers up, along with the rest of the equipment needed).

In building the footings for the circular concrete base of the towers, a comparatively new method known as "Rat Hole" digging is being used. These rat hole diggers sink a circular hole which widens out into a bell shape at the bottom. The hole and bell-shaped cavity are then filled with concrete, eliminating the need for wooden forms. Wooden forms are being used however, for the foundations of the service buildings and for the anchor blocks.

MODERN CAMPS

There are nine mobile camps in operation. These camps are modern, comfortable quarters made up of aluminum trailers used for bunkhouses, kitchen, cookhouses, storehouses and washrooms. One trailer in each camp is outfitted as a first-aid trailer with an industrial first-aid attendant on duty 24 hours a day. Most of these aluminum trailers are 10 feet by 40 feet mounted on wheels and fitted with storms and screens, oil heaters and removable stairs.

Fire protection consists of two 20 pound CO_2 fire extinguishers in each trailer plus a 200 foot water hose leading from the wash trailer. The bunkhouses sleep eight to 10 men each.

Each of the camps has a mobile lighting plant, propane gas tank, mobile radio telephone and a 1,000 gallon or larger water tank. The larger camps also have well-equipped ambulances which maintain radio-telephone contact with the local relay stations.

Each first-aid man acts as safety supervisor for his spread, assuming the safety administration functions with the superintendent. For the entire territory maps show the locations of all hospitals, private ambulances, landing strips, R.C.M.P. stations and doctors. Along the Alaska highway there are also emergency first-aid stations, attended by welfare nurses.

There were two steel bridges to be constructed on this project – one a 210 foot span across the Toad River, the other a 100 foot span across Freer Creek. The camp at the Toad River site had to use a helicopter to move the crew from the camp to the tower site for some months, due to the high level of the Toad River.

The two towers near the Alaskan border will need aerial tramways for access. It was proposed that tunnels 6 by 9 feet be driven on an incline of 30 degrees to give access to the towers at these sites, rather than aerial tramways as a safety feature. At other sites it may be necessary to build auxiliary aerial tramways for passengers and light loads, since it is feared that the top parts of the access roads may be blocked by snowslides and drifts during the winter.

In spite of their isolated location, the men received mail at least three times a week. Mail is taken up the Alaska highway by bus which operates as far as Whitehorse Yukon. Urgently needed parts and supplies are flown to the nearest air-strip and trucked by co-owned vehicles into the camp concerned. The task of supplying the camps with food is a vital responsibility which has yet to fail.

If a serious accident should occur there are landing strips operated by the Department of Transportation about every 100 miles along the Alaska Highway. Also in case of emergency there is the ever-present Royal Canadian Mounted Police officer, to lend his assistance wherever needed. These men are well-trained in first-aid.

This territory is not new to McNamara Construction as they built the branch of the Alaska Highway from mile 198 to 213 in 1942. They also built the sub-structure of the 1,134 foot Riard Bridge at mile 499.

Measuring SAFETY PERFORMANCE

by THOMAS H. ROCKWELL

ONE of the frustrations which has plagued those who labor in the field of accident prevention has been the problem of the measurement of safety performance. Safety practitioners and researchers alike are forced to measure the effectiveness of their work by vague, invalid and insensitive criteria such as lost time accidents, accident frequency rates or first aid cases.

The use of such poor measures of effectiveness complicates an already overly complex problem area which involves many misinterpreted, ill defined and unquantitative terms such as accident proneness, safety morale, job hazard, safe attitude, unsafe act, fatigue and safety motivation.

The problem of criterion measurement is not unique to the safety field. Measurement is an absolute prerequisite to control whether this be the control of production or accidents. Accurate measurement teamed with proper control provides prediction of future performance.

Present attempts to control accidents and their consequences can be well described as trial and error chiefly because adequate measures of the effectiveness of this control do not exist.

The safety engineer or supervisor in formulating an accident prevention program is continually confronted with this problem. Inspections, training programs, safety contests, etc., are initiated under various levels of effort and evaluated by the only measures available, namely, lost time accidents, first aid frequency or accident costs.

Because lost time accidents are rare events (especially when interpreted under ASA Z16.1-1954 R. 1959) and first aid cases are subject to serious reporting in accuracies, the safety director is faced with only an intuitive notion of the effectiveness of various accident prevention methods.

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The researcher in this field faces the same criterion problem. The inability to reproduce the accident phenomenon in the laboratory forces him to make use of criteria which are hopefully related to accidents, such as operator error (as operationally defined). Despite the fact that measurement is so critical in accident control, the majority of efforts in accident prevention have been concerned with techniques of control, such as guard design, training, etc. Little research has been devoted to the problem of how to evaluate the effectiveness of these control techniques.

One approach to this problem would be to consider some of the characteristics of a good criterion of safety performance. Of prime importance is the necessity for a criterion to be quantifiable.

Qualitative evaluation of safety performance prohibits statistical inference and opens the way for individual interpretation. The ideal criterion (a) of safety performance should permit statistical inferential procedures, because like most other measurable quantities dealing with human behavior, safety performance will necessarily be subject to statistical variation.

The criterion should also be valid or representative of what is to be measured. Does safety involve the minimization of disabling injuries and first aid cases or the minimization of all consequences of unsafe behavior and unsafe conditions? Near accidents

Thomas H. Rockwell, Ph.D., is associate professor of industrial engineering at Ohio State University. A member of the Central Ohio Chapter, Dr. Rockwell was the second place winner in the 1958-59 Technical Paper Awards program for his paper on "The Need for a Theoretical Framework in the Study of Accidents," published in the August, 1958 Journal.

or no injury accidents constitute a dilemma in this regard since their occurrence may result in a cost to the company and signal future disabling injuries. Moreover, the effect of unsafe behavior on production efficiency in the absence of property damage or injury may constitute a considerable cost to the organization and yet go on unmeasured.

Despite the fact that there is no injury or property damage, unsafe behavior of itself requires the attention of the safety supervisor. The oft-used accident frequency rate is thus a poor indicator of safety performance since it fails to take into account other associated consequences of unsafe behavior and unsafe conditions.

A third characteristic of an ideal measure of safety performance is that it should be reliable to the extent that it provides minimum variability when measuring the same condition. The repeatability of a measure is related to the accuracy or precision of the measurement itself. In safety this involves the notion of reporting.

First aid frequency has always had dubious reliability since under identical situations some workers will report for first aid while others will self-administer minor injuries. Associated with reliability is the need for a criterion to be stable. This involves the maintenance of a given range of values under repeated measure of worker behavior and environmental conditions.

An ideal measure of safety performance must also be sensitive to changes in environmental or behavioral conditions. This characteristic of a good criterion is significantly lacking in present-day safety measurement. Since lost time accidents are rare events, the initiation of a training program, for example, may not be reflected in reduced accident frequency rates.

EVALUATION IS DIFFICULT

With insensitive measures of safety preformance, the proper evaluation of accident prevention methods becomes extremely difficult. Finally, a criterion should be both efficient and understandable. Efficiency requires that the cost of obtaining and using the measurement is consistent with the benefit to be gained. Near accident measurement is a good instance of a criterion which requires excessive cost to obtain and verify.

To be understandable suggests that the criterion be of such nature that it can be comprehended by those charged with the responsibility of using or approving it. Statistical measures are often confusing to the uninitiated, and terms such as emotional instability, neurotic, etc., in addition to possessing inherent problems of quantification, have little meaning to the average manager.

These characteristics of a good criterion briefly outlined above are rarely achieved in any one measure. Sometimes a combination of measures can provide a reasonable compromise. The fact remains, however, that in the field of accident prevention, presently used measures of safety performance are inadequate in many of the characteristics cited. The criterion described below possesses many desirable criterion characteristics, particularly when viewed as a measuring instrument for research in safety problems.

CONTROL OF BEHAVIOR

Since the initiation of the safety movement after the turn of the century, more and more emphasis has been directed to the control of behavioral rather than environmental conditions which contribute to accidents. Alert safety departments armed with modern engineering methods and backed by state safety codes have eliminated the hazardous workshops which were born with the sudden industrialization of our economy.

Studies overwhelmingly point to the dominant role of unsafe behavior in accidents today. Heinrich's 88:10 ratio of personal to environmental causes of accidents while over-generalizing the situation, at least is indicative of the belief of accident preventionists (1).

Moreover, it is unfortunately true that despite efforts to safeguard equipment, workers often have little trouble removing this protection and subjecting themselves to injury. A glance at the efforts of safety practitioners shows that the principal share of time and dollar expenditures is directed at methods of promoting safe behavior. This does not suggest that unsafe conditions are nonexistent, but that the greatest gain in accident reduction lies in the elimination of unsafe behavior.

Viewed in another light, the initiation of such accident prevention methods as training programs, safety contests, propaganda, inspections, safety committees, etc., is principally designed to modify behavior and indirectly to reduce accidents. The difficulty suggested by this analysis is the problem of how this behavior is measured.

One method of measuring this behavior is to operationally define what constitutes unsafe behavior and measure the extent of its occurrence. Research has recently been conducted using activity sampling methods to estimate the extent of this unsafe behavior on a plant-wide basis (3).

This procedure has several advantages: A. it enables the collection of a large sample of behavior in a minimum of time; B. it permits the calculation of

sampling error; C. taken without operator cognizance, it provides a valid indicator of safety behavior.

The procedure essentially consists of an observer taking instantaneous random observations in time and noting whether the worker is engaged in safe or unsafe behavior. All worker behavior is thus dichotomized as safe or unsafe.

Unsafe behavior involves known violations of safety regulations or behavior which can be reasonably construed to be unsafe in consideration of existing environmental conditions. Usually the plant safety engineer and department foreman can list those instances of operator behavior which, for the particular job under study, have been known to result in first aid or lost time accidents, since the unsafe act is normally included in accident and first aid reporting.

It should be noted also that the procedure necessarily requires that the behavior be observable, e.g., it would be extremely difficult to use this method of measurement on operators working in concealed spaces.

A recent application of this method (2) was made to eight assemblers in a large aircraft manufacturing plant.[1] The eight workers included six men and two women, all of whom had been employed in this type of work for four years. Moreover, all had worked for the company for at least six years and had been equally exposed to plant safety regulations during this period.

TEST PROCEDURE

The purpose of the study was to evaluate this procedure as a criterion of safety performance in terms of its practicality, stability, sensitivity and relationship to other currently used safety criteria.

The determination of an unsafe act on this job was stipulated by the chief safety engineer and consisted principally of violations of company safety regulations and behavior specifically prohibited in this work. Each worker carried the same job description and performed the same tasks. The opportunity for commission of unsafe acts was assumed equal for every period in time since the work cycle was begun at all times throughout the day. These unsafe acts included the following:

1. Working with loose tools underfoot.
2. Working without goggles when required.
3. Working under suspended loads.
4. Failure to use guards as provided.
5. Working in unsafe postures.
6. Wearing improper or loose clothing.
7. Use of shock tools with mushroomed heads.
8. Improvising unsafe ladders and platforms.
9. Running.
10. Misuse of air hose.

The observer was instructed to take random samples (in time) of the eight operators from a catwalk above the job site. The workers were not aware of the study. In fact, in order to insure unbiased results, the department foreman was not informed of the survey until its completion.

Twenty observations of each operator were made for 17 work days. The results of the study are shown in Table 1. For each operator the daily proportion of unsafe behavior was recorded. Those days in which an operator was absent are indicated by the letter "A" followed by the average reading for that worker for the entire study.

CONVENTIONAL ANALYSIS

The data was first analyzed by conventional quality control chart methods. Figure 1 shows the group data plotted over the 17 days of the study. The data can be viewed as consisting of four distinct periods. The first period is one of stable performance; all values lie within 2 sigma limits of the average proportion of .175. The second period consists of the 3 days following the first safety inspection on the 8th day. The average proportion of unsafe acts here is .10. The third period shows the return of the group behavior to the original average proportion. The fourth period consists of the four days following the second inspection on the 14th day.

The effect of inspections on safety behavior is most striking when viewed in control chart terms.

TABLE 1.

Per Cent of Unsafe Behavior Observed for 8 Aircraft Assemblers

Day	Workers 1	2	3	4	5	6	7	8
1	16.6	35.2	31.5	00.0	21.0	16.6	5.0	21.0
2	15.8	A-25.4	33.3	5.2	20.0	5.2	10.5	27.8
3	00.0	27.8	27.8	11.1	26.3	00.0	10.0	25.0
4	29.4	33.3	47.3	00.0	22.2	15.8	5.5	21.0
5	33.3	27.8	21.0	5.2	10.5	22.2	00.0	5.5
6	36.8	29.4	20.0	5.0	21.0	5.5	00.0	10.5
7	21.0	38.8	10.5	10.5	10.5	15.8	15.0	45.0
8	00.0	11.8	15.8	00.0	5.0	00.0	00.0	16.6
9	15.8	5.9	5.9	5.5	15.8	5.0	22.2	15.8
10	10.5	20.0	5.5	5.0	15.8	00.0	5.2	22.2
11	21.0	47.0	22.2	0.0	25.0	00.0	00.0	5.9
12	15.8	25.0	42.0	5.2	16.6	00.0	15.8	26.3
13	26.3	20.0	11.8	00.0	A-14.4	11.1	15.0	33.3
14	15.8	21.0	11.1	00.0	10.5	00.0	A- 7.8	21.0
15	5.5	11.8	00.0	5.2	00.0	5.2	A- 7.8	25.0
16	11.1	10.5	00.0	00.0	00.0	5.2	A- 7.8	36.8
17	A-12.1	25.0	15.8	10.5	20.0	11.1	10.5	22.2

[1]The author is indebted to the Safety Department of North American Aviation, Inc., Columbus Division, for their generous cooperation in this study.

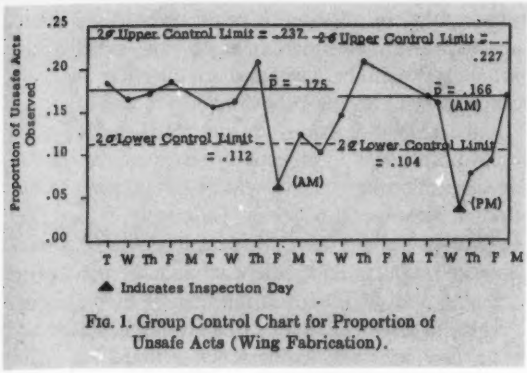

Fig. 1. Group Control Chart for Proportion of Unsafe Acts (Wing Fabrication).

The inspection on the morning of the 8th day dropped the proportion of unsafe acts from .21 to .06 and after 3 days the proportion returned to its previous level. This inspection was part of normal plant practice.

Each month the safety department made an unannounced inspection of each operating department. It was decided to coincide this inspection with the safety study to evaluate the effect of inspections on operator safety behavior. During the inspection, which took about 2 hours, both unsafe acts and unsafe conditions were checked. The assembly department received a high rating at this inspection.

At the request of the chief safety engineer a second inspection was made to evaluate the effect of consecutive inspections on the group. Although a second inspection was not usually made so soon after a previous inspection, it still had a sharp influence on safety behavior. The proportion of unsafe acts dropped from .165 that morning to .04 that afternoon and returned to normal after three days.

FURTHER ANALYSIS OF DATA

Further analysis of the data by analysis of variance methods showed that there was a significant difference at a .17 significance level between the mean performance of the individual operators. This same result was demonstrated with the data classified for all 17 days and for the 11 days of stable group performance (inspection effect removed).

With data cross classified by operator and all 17 days, the mean performance of the individual days was significant at the 5% level. With the inspection effect removed (i.e., days 8, 9, 10 and 14, 15, 16) there was no significant difference in day performance at the 20% level.

This supports the division of the total data into the four periods as shown in the control chart analysis. The difference in individual operator performance is also verified by inspection of Table 1 and the control chart analysis of Figure 2 where the behavior of two operators is shown. Worker No. 2 has the highest over-all average proportion and worker No. 4 has the lowest average per cent of unsafe behavior.

The data was also analyzed to determine the relationship between safety behavior and other indices of performance. The first question was whether one could predict lost time accidents or first aid frequency from knowledge of unsafe behavior. In examining the safety record of the eight assemblers it was found that none had ever had a lost time accident.

FIRST AID FREQUENCY

Using first aid frequency it was found that the top three of the eight workers in terms of unsafe acts accounted for 60 percent of the total first aid cases of the group. The use of rank correlation methods, however, yielded a coefficient of only +.245 when workers were ranked in terms of first aid cases and percent unsafe acts. The size of the sample of workers prohibits any conclusion about this analysis. However, there does appear to be some relationship which would warrant further investigation.

One question which is of extreme importance in using unsafe acts as a measure of safety performance is whether there is a relationship between production efficiency and percent unsafe acts. In the plant studied, no record of individual employee output was maintained, so no direct comparison was possible. After the study the foreman and assistant foreman were asked to rank the workers according to their productivity. Their combined rankings were compared to the ranking of the workers with respect to average percent unsafe acts. The resulting rank correlation coefficient was +.571.

Despite limitation in sample size the data strongly suggest that for this particular department some risks may be required for workers to be maximally

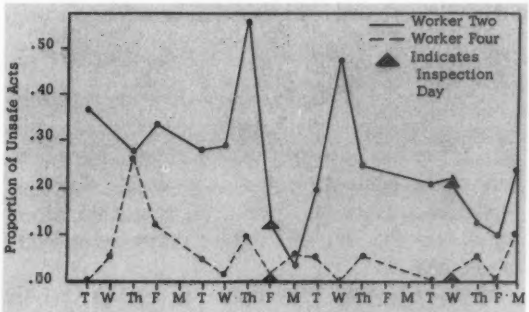

Fig. 2. Individual Control Chart for Proportion of Unsafe Acts (Wing Fabrication).

productive. This result is in sharp contradistinction to plant studies that positively relate safety and production efficiency (4).

A third analysis of the data was made to relate the occurrence of unsafe acts and time off the job (not absenteeism). The latter was available from the work sampling data. The workers were again ranked with respect to time off the job and average percent unsafe acts. The resulting rank correlation coefficient was +.552 which shows some positive relationship within the limits of the sample size. Further study might indicate whether time off the job and unsafe behavior are directly related or merely manifestations of some personal characteristics of the operator.

SUMMARY

The stability and sensitivity of this measure as demonstrated in Figure 1 in this study offers several interesting possibilities. The observed relationship between the proportion of unsafe acts and first aid frequency suggests that this measure may be used to predict lost time accidents and first aid cases *before* their occurrence. The small sample used in this study, however, prohibits any generalizations at this point.

The prospect of relating productivity and unsafe behavior certainly seems to warrant further study. It may well be that a positive relationship exists here that has been overlooked by safety practitioners. The consequences of unsafe behavior may not just be lost time accidents and first aid costs, but may involve a decrease in production efficiency and the cost associated with this inefficiency. Past research on the relation between safety and production efficiency has been on a plant-wide basis (4).

Such studies have simply shown that safe and efficient plants are compatible. This fact, however, has little significance because so many other factors are involved. An enlightened management is likely to be both safety conscious and efficient in production. With the suggested criterion of safety performance it would be possible to test this relationship on an *individual operator basis.*

Other research possibilities include the measurement of the effect of nearby accidents, safety training, supervision, propaganda methods, placement, and safety contests on operator unsafe behavior. Moreover, attitude tests could be given to workers to see if favorable attitudes toward safety are reflected in safe behavior.

If the effect of inspections on behavior can be measured as indicated in the reported study, then this might suggest the optimum allocation of inspection activity to various departments to obtain maximum results. In addition, it could provide the safety supervisor with information as to how often a department should be inspected to maintain the best results in terms of safe behavior.

If the results of this study are at all indicative, it would be possible to objectively test many of the assumed relationships in the field of safety, such as the effect of age on safe behavior. Ultimately, it might be possible to provide psychological tests which would correlate with unsafe behavior and permit better screening and placement at the time of employment.

This suggested measure of safety performance offers a new approach to the much debated "accident prone concept." Personal accident susceptibility would be measured in terms of personal exposure to accidents, i.e., unsafe behavior, instead of lost time accidents and first aid cases, with their associated reporting and causal complications.

Since this study was conducted over a short period of time and limited to a small sample of workers, no claim can be held that a breakthrough in the measurement problem in safety has been made. Many of the necessary conditions underlying this method are difficult to achieve in practice, such as independence between observations, the ability to dichotomize behavior as safe or unsafe, equal exposure to environmental hazards and equal opportunity for risk taking behavior. Furthermore, no attempt to scale the seriousness of the unsafe acts committed has been attempted.

Yet, the results of the reported study are encouraging and strongly suggest that further effort be devoted to this line of research. Certainly the magnitude of the accident problem today warrants intensive investigation. We cannot afford to be contented with our present lack of knowledge of this problem. The heavy loss of life and limb due to accidents in this country and the billions of dollars involved demand that every avenue of possible benefit be explored.

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Research on Hazards Associated with Production and Handling of Liquid Hydrogen, M. G. Zabetakis, D. S. Burgess. *U.S. Bureau of Mines – Reports of Investigations,* 5707 (1961) 50 p. Hazard due to formation of shock-sensitive condensed mixtures can be eliminated by excluding oxygen from all systems with which liquid hydrogen comes in contact; most obvious solution is to flush systems with inert gas such as nitrogen or helium: hazard due to fire can be minimized by judicious placement of vent stacks, combustibles, equipment, and buildings.

Safety at Gas-Processing Plants, G. M. Kintz, F. C. Hill. *U.S. Bureau of Mines – Bulletin,* 588 (1960) 98 p. Information on design, construction, operation, and maintenance of natural gasoline and gas-processing plants, with particular emphasis on procedures and practices that will promote maximum safety for workers.

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Safety Is Your Business, C. W. Rowsey. *Foundry* Vol. 89 No. 3 (March 1961) p. 88-93. History of safety progress at Hamilton Foundry, Hamilton, Ohio; details of safety organization, training, inspection and contests; achievements.

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Threshold 60-Cycle Fibrillating Currents, C. F. Dalziel. *American Institute of Electrical Engineers–Transactions,* Vol. 79 part 3 (Power Apparatus & Systems) No. 50 (October 1960) p. 667-73. Additional data to support author's formula for threshold currents for men (see Engineering Index 1946 p. 314, 1953 p. 293). In case of ventricular fibrillation on heart, due to electric shock. Paper 60-40.

What Are Facts on State Safety Codes? R. L. McKee. *Grinding & Finishing* Vol. 7 No. 3 (March 1961) p. 36-7. It is stated that 15 states still have no regulations for grinding wheel use, and only 13 have provisions matching ASA Code; state-by-state survey presented shows trend toward better control.

MOTOR VEHICLE SAFETY

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NOISE CONTROL

Significance of Sound, R. B. Newman. *Consulting Engineer* (St. Joseph, Mich.) Vol. 15 No. 6 (December 1960) p. 94-7. Building acoustics must consider both sound isolating value of separating construction and background noise in occupied space; basic principles; features of ideal partition which is mass controlled system with very little stiffness; effects of mass and stiffness on transmission loss; design problems.

Zur Laerabelastung von Huettenarbeitern, G. Jansen. *Stahl und Eisen,* Vol. 81 No. 4 (February 16 1961) p. 217-20. Adverse effects of noise on iron and steel worker; examination of over 1000 workers showed that noise damages not only hearing but vegetative functions of men; wide strip noises were found especially harmful, on working as well as resting man.

NUCLEAR SAFETY

Critical Safety. *Engineering,* Vol. 191 No. 4951 (March 10, 1961) p. 355-6. Table of some nuclear reactor accidents which occurred between 1947-48 and January 1961, gives date, reactor, location, and type of accident for 41 instances; some accidents in 1960 are discussed more fully, and information is given on stationary low power reactor (SL-1) explosion at Idaho Falls, in United States, which occurred in January 1961 and is under investigation.

Industrial Biological and Medical Aspects of Microwave Radiation, A. F. Harvey. *Institution of Electrical Engineers Proceedings,* Vol. 107 part 8 (Electronic & Communication Eng.) No. 36 (November 1960) p. 557-66. Special methods for studying properties of organic and biological materials; industrial applications of microwave heating processes; effect of microwave radiation on biological tissues and living animals; how operational hazards to personnel in neighborhood of high-power equipment can be minimized. 108 refs. Paper 3315E.

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AMERICAN SOCIETY OF SAFETY ENGINEERS

Membership Information

THE American Society of Safety Engineers has established the following classifications of active membership.

ASSOCIATE MEMBER – To be eligible as Associate Member an applicant shall be at least twenty (20) years of age and

a. Shall have a degree in engineering from a college or university whose curriculum is accredited by the Engineers' Council for Professional Development or shall have legal registration as a professional engineer and, in addition, shall be engaged in safety engineering with at least one (1) year's experience, no time being credited to this one (1) year unless at least fifty (50) per cent of the time was devoted to safety engineering, or shall have supervision over the safety engineering function of his organization; or

b. Shall have a college degree other than that specified in "a" above and, in addition, shall be engaged in safety engineering with at least three (3) years' experience, no time being credited to this three (3) years unless at least fifty (50) per cent of the time each year was devoted to safety engineering; or

c. In lieu of a college degree, shall be engaged in safety engineering with at least five (5) years' experience, no time being credited to this five (5) years unless at least fifty (50) per cent of the time each year was devoted to safety engineering.

MEMBER – To be eligible as a Member an applicant shall be at least thirty (30) years of age, shall have the qualifications required for Associate Membership and also shall have (5) years' experience in addition to that required by and of a type defined in the subsection of the requirements for Associate Member which is applicable to him.

FELLOW – To be eligible as a Fellow, a Member shall be nominated upon the unsolicited recommendation of three (3) other Members, shall be at least forty (40) years of age, shall have been a Member for at least thirteen (13) years, and shall have been engaged in safety enginering for at least twenty (20) years, during at least five (5) years of which he shall have been in responsible charge of the safety engineering function of his organization. In addition, he shall have made an outstanding contribution to the safety engineering profession. Recommendations of candidates for the Fellow classification, along with substantiating data, shall be sent to the Secretary of the Society, who shall submit such recommendations and substantiating data to the Committee on Membership. The Committee on Membership shall report its findings to the Executive Committee for action. Fellows shall be elected by a majority vote of the Executive Committee.

AFFILIATE MEMBER – To be eligible as an Affiliate Member an applicant

a. Shall be at least twenty (20) years of age and shall be engaged in safety engineering with at least one (1) year's experience, no time being credited to this one (1) year unless at least fifty (50) per cent of the time was devoted to safety engineering; he may remain in this classification while qualifying for Associate Member or Member Classification; or

b. Not being engaged in safety engineering, shall be at least twenty-five (25) years of age and shall have pursuits, attainments in accident prevention, or practical experience, extending over a period of at least three (3) years, which shall qualify him to cooperate with members of the Society and to render service to the Society.

for additional information write to

The American Society of Safety Engineers
5 North Wabash Avenue, Suite 1705, Chicago 2, Illinois
(or contact your local chapter)